OIPE JC116 SEP 1 9 2000 PATENT & TRADEMARK OFFICE

AF/CP 2877

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	Atty. Docket
FUCHS ET AL.	PHA 23,578
Serial No. 09/087,141	Group Art Unit: 2877
Filed: May 28, 1998	Examiner: S. TURNER

Title: METHOD AND DEVICE FOR MEASURING THIN FILMS AND SEMICONDUCTOR SUBSTRATES

Commissioner of Patents and Trademarks
Washington, D.C. 20231

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APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Sir:

Appellants present their brief on appeal as follows:

REAL PARTY OF INTEREST

The real party of interest is the assignee, U.S. Philips Corporation, and not the parties named in the above caption.

RELATED APPEALS AND INTERFERENCES

With regard to identifying by number and filing date all other appeals or interferences known to appellants which will directly effect or be directly affected by or have a bearing on the Boards' decision in this appeal, Appellants are not aware of any such appeals or interferences.

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STATUS OF THE CLAIMS

Claims 1-46 stand rejected and are appealed.

STATUS OF AMENDMENTS

An "Amendment After Final Rejection" was presented subsequent to the final rejection. In an Advisory Action dated July 28, 2000, this Amendment was not entered as raising new issues that would require further consideration and/or search, and for not placing the application in better form for appeal by materially reducing or simplifying the issues for appeal.

SUMMARY OF THE INVENTION

An apparatus (See Fig. 4) and method for measuring a property of a structure using "reflection mode" geometry are provided. The apparatus (50) includes a microchip laser (52) which irradiates and initiates time-dependent acoustic phonons in a sample (10). A probe laser (54) measures the response by reflection off the sample to generate a signal waveform. The signal waveform is detected with a high-speed photodetector (80) and then analyzed to determine the property of interest.

THE ISSUES

1) Whether under the judicially created doctrine of obviousness-type double patenting, the differences between the

invention of Claims 1-13, 15-19, 21-34, and 45 and Claims 1-8 and 25 of and U.S. Patent 5,734,470 (Rogers-I) in view of U.S. Patent 5,394,413 (Zayhowski) are such that the inventions are not patentably distinct.

2) Whether under the judicially created doctrine of obviousness-type double patenting, the differences between the invention of Claims 1-13, 15-19, 21-34, and 45 and Claims 1-22 and 19-33 of U.S. Patent 5,812,261 (Nelson et al.) in view of Zayhowski are such that the inventions are not patentably distinct.

3) Whether under 35 U.S.C. § 103(a), the differences between the invention of Claims 1-34 and 45 and U.S. Patent Rogers-I in view of Zayhowski and of Claims 35-44 and 46 and U.S. Patent 5,546,881 (Rogers-II) in view of Zayhowski as applied to Nelson et al. (Journal of Applied Physics 2/1982) are such that the invention as a whole would have been obvious when the invention was made to those of ordinary skill in the art.

PRIOR ART

1. U.S. Patent 5,734,470 (Rogers-I)
2. U.S. Patent 5,546,881 (Rogers-II)
3. U.S. Patent 5,394,413 (Zayhowski)
4. U.S. Patent 5,812,261 (Nelson)
5. Journal of Applied Physics 2/1982 (Nelson et al.)

GROUPING OF CLAIMS

With regard to the rejection of Claims 1-13, 15-19, 21-34, and 45 under the judicially created doctrine of obviousness-type double patenting, and Claims 1-46 under 35 U.S.C. § 103, the claims of both groups stand or fall together.

ARGUMENT

There is no teaching or suggestion in Rogers-I, Rogers-II, Nelson, or Zayhowski of using a microchip laser and detecting of a reflected signal beam, as recited in Claims 1, 35, 45, and 46.

For example, one advantageous feature of the system defined in Claim 1 is that data collection in reflection mode geometry are optimized when the peaks and nulls of the grating are stationary relative to the focused probe beam (see page 7, lines 9-11). As described in the specification, when the peaks and nulls of the grating are stationary, measured data has a constant phase and a well-defined frequency. Consequently, from these data sample properties can be more accurately measured (see page 13, line 29 to page 14, line 5).

The Final Office Action dated April 13, 2000 states that the limitations of Rogers-I and Nelson have a scope which includes all limitations in the rejected claims except for the microchip laser, which is taught by Zayhowski. However, it is respectfully submitted that, as understood by Appellants, Claims 1-8 and 25 of Rogers-I and Claims 1-22 and 19-33 of Nelson

clearly indicate that a <u>diffracted</u> signal is detected (i.e., a diffraction mode measurement). One of ordinary skill in the art will appreciate that the detection and analysis of refracted versus diffracted beams are different. In reflective mode, accurate measurements are generated by fixing the phase of the excitation pattern (see element 15 in Fig. 4) relative to the probing area so that the spatial jitter between these components is minimized. The apparatus defined by Claim 1, in part, by the use of the microchip laser and the detection of reflected signal beams accomplishes this.

Additionally, Appellants have discovered that when a small scale microchip laser (as recited in the independent claims) is used in conjunction with a reflective mode (as also recited in the independent claims), the signal-to-noise ratio of data collection is increased. This, in turn, improves the precision and accuracy to which a sample is measured. (See page 7, lines 9-21, of the specification).

The Final Office Action dated April 13, 2000 states that the Rogers-II in view of Zayhowski and Nelson et al. obviate the invention. However, it is respectfully submitted that, as understood by Appellants, Rogers-II only recites measuring the component of an optical probe field diffracted off the sample (see, e.g., Col. 1, lines 46-47, Col. 16, lines 13-15).

The Advisory Action dated July 28, 2000 states that the argument of reflection versus diffraction raised in the Appellants' Amendment After Final dated July 18, 2000 fails to address the 0-order diffraction which is the specular reflection. Appellants submit that, as stated in Rogers-I in Col. 7, line 65 to Col. 8, line 1, the zeroth order is spatially filtered and the +1 and -1 diffracted orders are used to generate measurements. Rogers-II and Nelson et al. also recite generating measurements using only diffracted orders of the probe beam. This difference further delineates between the invention and the cited art, as in the invention, only the reflected beam is detected and measured.

While Appellants believe that the dependent claims are independently patentable over the cited art, no additional arguments are presented at this time.

CONCLUSION

For all of the above reasons, it is respectfully submitted that the final rejection of claims 1-46 is in error[1]. Accordingly, reversal of the final rejection of each of these claims is respectfully solicited.

This brief is being filed in triplicate.

Appellant notes that in the Amendment After Final Rejection, Claim 35 was amended to remove the recitation of diffraction. Appellants hereby again propose this amendment to Claim 35 if the claims are below found allowable for the reasons stated above.

The Commissioner is hereby authorized to credit any overpayment or charge any fee (except the issue fee) to Account No. 14-1270.

Respectfully submitted,

By____________________

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to:

Commissioner of Patents & Trademarks
Washington, D.C. 20231

on Sept. 13, 2000
Elissa De Lucey

APPENDIX

1. An apparatus for measuring a property of a structure, comprising:

a microchip laser that generates an optical pulse;

a diffractive element that receives the optical pulse and diffracts it to generate at least two excitation pulses;

an optical system that receives at least two optical pulses and spatially and temporally overlaps them on or in the structure to form an excitation pattern that launches an acoustic wave, electronic response, or thermal response that modulates at least a portion of the structure;

a light source that produces a probe beam that reflects off the portion of the structure to generate a signal beam;

an optical detection system that receives the signal beam and in response generates a light-induced electrical signal; and

an analyzer that analyzes the light-induced electrical signal to measure the property of the structure.

2. The apparatus of claim 1, wherein the diffractive element is a mask that comprises an optically transparent substrate that comprises a pattern comprising a series of parallel trenches having a spatial periodicity of between 0.1 and 100 microns.

3. The apparatus of claim 2, wherein the mask is a phase mask.

4. The apparatus of claim 3, wherein the phase mask comprises a plurality of patterns.

5. The apparatus of claim 1, wherein the laser is a diode-pumped laser.

6. The apparatus of claim 5, wherein the laser is a passively Q-switched laser.

7. The apparatus of claim 6, wherein the laser comprises Nd:YAG, titanium:sapphire, chromium:LISAF, or a fiber laser.

8. The apparatus of claim 7, wherein the Nd:YAG is comprised by a layer having a thickness less than 5 mm.

9. The apparatus of claim 1, wherein the portion of the structure is a surface.

10. The apparatus of claim 9, wherein the acoustic wave generates a time-dependent ripple on the surface.

11. The apparatus of claim 10, wherein the probe beam is aligned to deflect off the time-dependent ripple to form the signal beam.

12. The apparatus of claim 11, wherein the optical detection system comprises a detector that generates an electrical signal that changes when a deflection angle of the probe beam changes.

13. The apparatus of claim 12, wherein the optical detection system comprises a detector that comprises a single photodiode.

14. The apparatus of claim 13, wherein the detector comprises at least two photodiodes.

15. The apparatus of claim 1, wherein the modulated optical, mechanical, or physical property is a temperature.

16. The apparatus of claim 11, wherein an optical, mechanical, or physical property is modulated in the portion by the acoustic waves.

17. The apparatus of claim 16, wherein a refractive index or absorption coefficient is modulated.

18. The of claim 16, wherein the probe beam is aligned to reflect off the area comprising the modulated absorption coefficient or refractive index.

19. The apparatus of claim 18, wherein the optical detection system is configured to detect a phase of the signal beam.

20. The apparatus of claim 19, wherein the optical detection system comprises an interferometer.

21. The apparatus of claim 1, wherein the optical system comprises at least one lens that collects and overlaps the excitation pulses on or in the structure.

22. The apparatus of claim 21, wherein the optical system comprises a lens pair having a magnification ratio of about 1:1.

23. The apparatus of claim 1, further comprising a lens that focuses the probe laser beam onto the portion.

24. The apparatus of claim 23, wherein the acoustic waves generate a time-dependent ripple morphology in the portion, and the probe beam irradiates a peak, null, a region between a peak or null, or a portion thereof in the ripple morphology.

25. The apparatus of claim 23, wherein the portion undergoes a time-dependent change in refractive index or absorption coefficient.

26. The apparatus of claim 1, wherein the analyzer is configured to determine a frequency or phase velocity of the acoustic waves.

27. The apparatus of claim 26, wherein the structure comprises at least one layer.

28. The apparatus of claim 27, wherein the analyzer is configured to analyze the frequency or phase velocity to determine a thickness of the layer.

29. The apparatus of claim 28, wherein the analyzer is configured to calculate a thickness of the layer by analyzing the frequency or phase velocity, a density of the layer, and a wavelength of the excitation pattern.

30. The apparatus of claim 28, wherein the structure comprises a plurality of layers, and the analyzer is configured

to analyze the light-induced electrical signal to determine the thickness of more than one layer in the structure.

31. The apparatus of claim 27, wherein the analyzer is configured to determine the density, resistivity, adhesion, delamination, elasticity, roughness, or reflectivity of the structure or the layer in the structure.

32. The apparatus of claim 27, wherein the structure comprises a semiconductor.

33. The apparatus of claim 32, wherein the layer is a metal film.

34. The apparatus of claim 33, wherein the metal comprises aluminum, tungsten, copper, titanium, tantalum, titanium:nitride, tantalum:nitride, gold, silver, platinum, or alloys thereof.

35. An apparatus for measuring a property of a structure, comprising:

a passively Q-switched microchip laser that generates an optical pulse;

a photodiode that receives a portion of the optical pulse to generate a trigger pulse;

a first optical system that receives the optical pulse and separates it into at least two excitation pulses;

a second optical system that receives at least two optical pulses and spatially and temporally overlaps them on or in the structure to form an excitation pattern that launches an acoustic wave, an electronic response, or a thermal response that modulates at least a portion of the structure;

a light source that produces a probe beam that reflects or diffracts off the portion to generate a signal beam;

an optical detection system that receives the signal beam and in response generates a light-induced electrical signal;

a data-acquisition system that receives the light-induced electrical signal and the trigger pulse and, in response, generates a data signal; and

an analyzer that analyzes the data signal to measure the property of the structure.

36. The apparatus of claim 35 wherein the first optical system comprises a diffractive element.

37. The apparatus of claim 36, wherein the diffractive element is a phase mask.

38. The apparatus of claim 35, wherein the passively Q-switched laser is a diode-pumped laser.

39. The apparatus of claim 38, wherein the passively Q-swiched laser comprises Nd:YAG, titanium:sapphire, chromium:LISAF, or a fiber laser.

40. The apparatus of claim 39, wherein the Nd:YAG is comprised by a layer having a thickness of less than 5 mm.

41. The apparatus of claim 35, wherein an optical, mechanical, or physical property of the structure is modulated in the portion of the structure.

42. The apparatus of claim 41, wherein the probe beam is aligned to deflect or diffract off the optical, mechanical, or physical property to form the signal beam.

43. The apparatus of claim 42, wherein the modulated optical property is a refractive index or absorption coefficient.

44. The apparatus of claim 42, wherein the modulated optical property is a refractive index or absorption coefficient.

45. A method for measuring a property of a structure, comprising the steps of:

generating an optical excitation pulse with a diode-pumped microchip laser;

diffracting the optical pulses with a diffracting element to generate at least two excitation pulses;

spatially and temporally overlapping the excitation pulses on or in the structure to form an excitation pattern that launches an acoustic wave, an electronic response, or a thermal response that modulates at least a portion of the structure;

reflecting a probe beam off the portion to generate a signal beam;

detecting the signal beam to generate a light-induced electrical signal; and

analyzing the light-induced electrical signal to measure the property of the structure.

46. A method for measuring a property of a structure, comprising:

generating an optical pulse with a passively Q-switched microchip laser;

generating a trigger pulse by detecting a portion of the optical pulse;

separating the optical pulse into at least two excitation pulses;

spatially and temporally overlapping the optical pulses on or in the structure to form an excitation pattern that launches an acoustic wave, an electronic response, or a thermal response that modulates at least a portion of the structure;

reflecting or diffracting a probe pulse off the portion to generate a signal beam;

detecting the signal beam to generate a light-induced electrical signal;

processing the light-induced electrical and the trigger pulse with a data-acquisition system to generate a signal; and

analyzing the signal to measure the property of the structure.